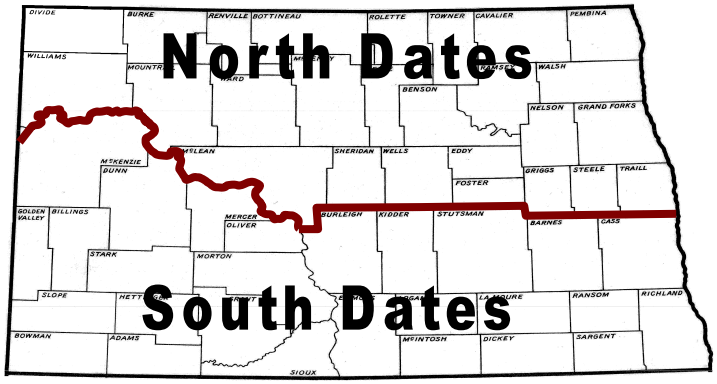
Herbaceous Vegetation Establishment Guide

1. Seeding Dates:

Seeding dates are based on climatic records, research, and experience; and represent optimum periods for grass and legume establishment. These dates should provide for adequate development of adventitious roots prior to stressful periods, such as hot, dry summers and cold, open winters. The following table shows recommended seeding dates by MLRA's. Variation from these dates plus or minus 5 days may be made if justified by moisture and temperature conditions.



Seeding Dates		
Species Type and Season of Planting	**NORTH** (53A, N.1/2 53B, 55A, N. ½ 56, N. 1/3 55B)	**SOUTH** (58C, 58D, 54, S. ½ 53B, S. 2/3 55B, S. 56)
Cool Season Species:		
Spring	Prior to May 20th	Prior to May 10th
Late summer [1]	August 10th to Sept 1st	August 10th to September 15th
Late fall (dormant) [2]	After October 20th	After November 1st
Warm Season Species:		
Spring	May 10th to June 25th	May 10th to June 25th
Warm/Cool Season Mix		
Spring	May 1 to June 15	April 20 to June 1

[1] If legumes are part of a mixture, seed by August 25th. It is essential that alfalfa plants reach the 6-leaf stage prior to fall dormancy, for winter survival. Alfalfa requires 6-8 weeks growth after emergence to develop the 6-leaf stage.

[2] Late fall seeding dates are for dormant seedings. Seeding may occur once soil temperatures drop to 40° Fahrenheit for a minimum of 5 consecutive days based upon North Dakota Agriculture Weather Network http://ndawn.ndsu.nodak.edu/index.html or actual field measurements at a depth of 2 inches.

2. Seedbed Preparation:

A. A seedbed will be prepared that is free of competing vegetation and is not subject to excessive erosion. A firm seedbed will be provided so the seed is placed at the designed depth. **IT SHOULD BE FIRM ENOUGH SO THAT ADULT FOOTPRINTS ARE HARDLY VISIBLE**.

B. The presence or absence of weed populations, especially noxious weeds, will impact seedbed preparations. Each field should be evaluated for weed pressure. Seeding on fields with significant weed populations will be delayed until weeds are controlled. This may mean a protective cover crop may need to be planted.

C. When planning a seeding, the previous two years of herbicide application should be considered. Any potential carryover problems should be addressed by delaying seeding, establishing a cover crop, and/or changing species to be planted. If a cover crop is necessary, refer to part 6 of this tech note.

D. Seedbed alternatives

1. No-Till Method - Seeding into standing stubble of a previous crop without further seedbed preparation. Excess straw or chaff should be removed prior to seeding. Use of harvest equipment, which spreads straw along a minimum of 80% of the header width, will prevent excess chaff problems. If weeds or excessive volunteering of previous crop is present, control with appropriate herbicide(s) in accordance with product label directions and current recommendations from North Dakota State University Cooperative Extension Service (Agricultural Weed Control Guide, Cir. W-253 Rev.). http://www.ag.ndsu.nodak.edu/cropprod.htm

2. Rye produces an allelopathic agent that may inhibit germination in many grass species. If possible, avoid seeding into rye stubble or heavy rye residue. Other commonly grown crops provide good cover and do not inhibit germination.

3. Cover Crop Method – Plant a cover crop (high residue producing crop) of oats, barley, flax, grain sorghum, millet, or sudangrass during the growing season before seeding perennial forages if existing cover is insufficient to control erosion. If the cover crop method is to be used, see part 7.

4. Clean-Till Method – Seed into a new, clean tilled, firmly packed seedbed. If erosion or potential climatic factors are a potential concern, a cover crop may be used. See part 6 if a cover crop is to be used.

3. Seeding Equipment:

Seeding equipment that ensures proper seed placement and good seed–soil contact will be used. Modern grass seeding attachments that allow for proper seed flow, seed placement and soil packing are needed to ensure a successful seeding.

Slower seeding speeds should be used for fluffy or rough-coated seed species. Three to five miles per hour should be the seeding speed for most types of grass drills. Seeding speeds in excess of 6 miles per hour may result in uneven or inconsistent grass and legume stands.

If a carrier is needed to help feed seed through the drill cracked corn or rolled oats may be added to the mixture.

A. Grass Drill

Grass drills are specifically designed and equipped to properly meter and place various grass, legume and/or forb seed and share the following design characteristics.

1. Different seed boxes are normally required to handle the three types of grass seed commonly used. This includes the relatively clean, smooth seed characteristic of many cool-season grasses, the chaffy or trashy seed characteristic of many warm-season grasses, and fine, smooth seed, characteristic of legumes or grasses such as switchgrass, hard fescue, or reed canarygrass.

   Seed boxes having the capability of seeding chaffy or awned grasses (i.e. blue grama, bluestems, and indiangrass) are needed, only if such species are planned in the seeding mixture; likewise, fine-seed or legume seed boxes are needed, only if such species are to be seeded.

2. Agitators or similar mechanisms that prevent bridging of chaffy or trashy seed and ensure a constant flow of seed at the desired rate with uniform mixing of the species in the mixture.

3. Feeder mechanism (picker wheels, fluted feed, etc.) that ensures uniform flow of all types of grass seed either separately or in a mixture.

4. Oversized feeder tubes that allow constant flow of chaffy or trashy type seed from boxes to placement point (if such seed is used).

5. Individually mounted, adjustable, spring loaded, double-disc openers.

6. Depth bands or other depth-control systems that provide positive seed placement for final planting depth of one-fourth to one inch over varying degrees of seedbed firmness.

7. Press/packer wheels that provide adequate covering and firming of soil over and around the seed for necessary seed/soil contact after proper seed placement. They should be mounted individually on each furrow opener or independently to follow behind each opener. Press/packer wheels are not intended to provide the basic "firm seedbed". The firm seedbed must exist before the drilling operation begins.

8. Drill calibration should be completed for both grass and grain drills prior to seeding. Refer to item 4 for guidance in completing drill calibration.

B. Small Grain Drill

1. Free-flowing grass seed (i.e., wheatgrasses) and legume seed can be successfully planted with a small grain drill, provided proper seeding depth can be maintained throughout the field. Seeding depth is the most limiting factor to seeding success and contributes to most of the seeding failures when using a grain drill. It is extremely important to have a firm seedbed when using a grain drill. Periodic inspections should be done to check seeding depth especially

when seeding across different soil types. Seeding depth will vary under actual planting conditions.

2. Checking the drill frequently and hand mixing the seed is essential to achieving a properly blended seed mix and helps ensure that seeds of different sizes are seeded evenly across the field. Periodic feeder mechanism adjustments are usually necessary to ensure proper seeding rates. A separate legume box is desirable for seeding small seeded species. (i.e. switchgrass, hard fescue, reed canarygrass, and alfalfa). Ensure that the grain drill's drop tubes are placed in front of the packer wheels to allow for proper seed-soil contact.

3. Chaffy or awned seeds (i.e. bluestems, indiangrass, and blue grama) are extremely difficult to plant with a grain drill. It is recommended that a grass drill be used for these types of grasses. Proper agitation is needed to prevent "bridging" of seed in the seedbox, and the feeder mechanism must be capable of metering a uniform flow of seed at the desired rate. Very few grain drills have this capability. Use of debearded seeds is strongly recommended when considering seeding chaffy or awned seeds in a grain drill.

C. Broadcast Seeder

Broadcast seeding may only be used when seeding some legume species (i.e. alfalfa, sweet clover). Obtaining proper seed depth is very difficult with broadcast seeders. All broadcast seedings shall have an operation which incorporates the seed into the soil (i.e. covering operation using a drag harrow, cultipacker, roller packer, or other suitable implement to cover and press the seed into the soil surface).

D. Airseeders

Some airseeders and similar types of equipment may be used to seed free flowing grass seed (i.e., wheatgrasses) and legume seed if proper seeding depth can be obtained (as specified in part 6). The shallow planting depths for grasses and legumes can be difficult to maintain with this type equipment. The equipment must be able to provide a uniform flow of seed at the desired rate. Use packer wheels or other suitable packing implement to press soil firmly around the seeds.

4. Drill Calibration:

Grass or grain drills may be calibrated using the following methods.

Bulk weight method:
Raise the drill's drive wheel and measure its circumference in **feet**. Next, measure the distance between seed spouts or disc openers. Use Table A to determine the number of revolutions (R) to turn the drive wheel for the row spacing and wheel circumference in feet (C) for your drill.

Table A

Row spacing in inches	No. of Seed Spouts to Use	Turns of Drive Wheel	Row spacing in inches	No. of Seed Spouts to Use	Turns of Drive Wheel
6	4	96/C = R	24	1	96/C = R
7	4	82/C = R	30	1	77/C = R
8	3	96/C = R	36	1	64/C = R
10	3	77/C = R	42	1	55/C = R
12	2	96/C = R	48	1	48/C = R

Place enough seed in the box to cover spouts from which you will collect seed. Turn the drive wheel until all spouts are feeding. Place a container under the correct number of seed spouts (as determined from the Table A) and turn the drive wheel the number of revolutions previously determined. Weigh the sample in grams. Multiply this weight by 0.5. The result is the pounds per acre at that setting. Make adjustments in the drill setting and continue trials until the desired seeding rate is obtained. **Remember**: Seeding rates as determined by this method are in terms of **bulk seed**. You need to convert your seeding rate from pure live seed per acre to bulk seed per acre when using this calibration method.

Example:

Row spacing = 7 inches
Number of seed spouts = 4
Circumference of drive wheel = 6.8 ft
Revolutions of drive wheel (R) = 82/C
R = 82/6.8 = 12 revolutions

Bulk seeding rate is 15.1 lbs./ac. The drill is properly set when the 4 seed spouts yield 30 grams of seed after 12 revolutions of the drive wheel.
30 grams x 0.5 = 15 lbs./ac

Seeds per row foot method:

This method of determining the amount of seed being distributed by the seeding equipment is to count the number of seeds per foot of drill row while the machine is in operation.

Fill the drill with seed, make setting, and drive equipment over a hard ground surface or canvas. Count the number of seeds per foot of row and adjust until proper seeding rate is attained. Use Table B to determine the linear foot of row necessary to equal one square foot planted.

Table B

Row spacing in inches	Linear foot of row to equal one square foot
6	2.0 feet
7	1.8 feet
8	1.5 feet
10	1.2 feet
12	1.0 foot

To determine the proper number of seeds per foot of drill row for a specific seeding mixture; you will first need to calculate the bulk seeding rate for each species in the mix. From Table 1, calculate the number of seeds per square foot (ft^2) for each pound seeded (seeds per pound divided by 43,560 ft^2/acre). Multiple the number of seeds per square foot for each pound seeded by the bulk seeding rate for each species. Total the resulting numbers to determine the number of seeds per square foot for the mixture.

For example: If you want to calibrate a drill for a mixture of 4.5 lbs. PLS/ac green needlegrass (80% purity and 70% germination) and 4.0 lbs. PLS/ac western wheatgrass (92% purity and 85% germination), we would calculate the bulk seeding rate for each species. Bulk seeding rate would be 8lbs. /ac for the green needlegrass and 5.1 lbs./ac for the western wheatgrass. Table 1 shows one pound of green needlegrass seed contains 180,000 or 4.1 seeds/ft^2 for each pound seeded (180,000/43,560 ft^2/acre). Western wheatgrass has 112,000 seeds per pound or about 2.6 seeds/ft^2 for each pound seeded.

8 lbs./ac x 4.1 seeds/ft^2/lb. = 32.8 seeds/ft^2
5.1 lbs./ac x 2.6 seeds/ft^2/lb. = 13.3 seeds/ft^2

The total seeds per square foot for the mix would be 46. If the drill we are calibrating has 7-inch row spacing, the drill calibration would be 46 seeds per 1.8 feet of row length.

5. Seed Requirements:

A. All seed must meet the requirements of North Dakota State Seed Laws and Regulations. Information on state seed law is available at http://www.state.nd.us/seed/regulatory/ or Chapter 4-09 of the ND Century Code available at http://www.state.nd.us/lr/. All seed; including homegrown seed, must be officially tested for purity and germination to enable pure live seed (PLS) calculations for determining the proper seeding rate. Tests must be made within a nine-month period, exclusive of the test month, prior to seeding. Recommend re-testing of seed within the nine month period if stored improperly (high humidity and/or high temperature).

B. Use certified seed when available.

C. Origin of non-varietal ('common') grass seed of both native and introduced species for pasture and hayland planting is limited to North Dakota, South Dakota, Nebraska, Montana, Wyoming, Minnesota, Alberta, Saskatchewan, and Manitoba.

D. Foreign seed, except Canadian, must be of adapted, named varieties, see Table 2.

E. Origin of non-varietal ('common') alfalfa types is limited to North Dakota, South Dakota, Minnesota, Montana, Alberta, Saskatchewan, and Manitoba.

F. Legume seed should be inoculated with the proper culture just prior to seeding in order to increase the potential for nitrogen fixation by the plant.

G. No noxious weed amounts are allowed on any seed tags.

H. All seeding rates will be based on pure live seed (PLS). PLS can be calculated from information on the seed tag. PLS is derived by multiplying percent pure seed by percent germination (plus percent hard seed, if present) and dividing by 100. See ND Extension Service publication A-353 "Farmer's Guide for Seed Buying" at http://www.ext.nodak.edu/extpubs/crops.htm.

6. Seeding Depth:

Proper seeding depth is extremely important in successfully establishing native and introduced vegetation from seed. Native grasses, forbs, and shrubs need to be seeded at a shallow depth, as light plays a key role in the germination of many native species. Optimum seeding depths are ¼ to ¾ inch.

7. Cover and Companion Crops:

A. Cover Crops

1. A cover crop is an annual residue-producing crop, planted during the growing season before seeding the perennial crop. Its purpose is to provide cover and residues to reduce evaporation, maintain cool soil temperatures, smother or reduce weeds, trap snow, protect seedlings from extreme climatic conditions and control wind and water erosion.

2. Cover crops may be used in all MLRA's at the following rates and seeding dates:

Crop	Seeding rate	Spring Dates	Fall Dates
Barley	25 - 30 lbs./acre	Apr. 15 - June I	Aug. 15 - Sept. 1
Spring wheat	30 - 35 lbs./acre	Apr. 15 - June I	
Oats	15 - 30 lbs./acre	Apr. 15 - June 1	Aug. 15 - Sept. 1
Flax	8 - 10 lbs./acre	May 1 - June I	Aug. 1 - Aug. 25
Grain sorghum	5 - 10 lbs./acre	May 15 - Aug. 15	
Millet	10 - 15 lbs./acre	May 15 - Aug. 15	
Sudangrass	15 - 20 lbs./acre	May 15 - Aug. 5	

3. The cover crop should be clipped to 8-10 inches in height or chemically killed during the boot stage to prevent seed formation. Remove or spread excess residues that would interfere with drilling the perennial species.

B. Companion Crops

1. A companion crop is an annual that is planted with the perennial species. Companion crops not recommended because of excessive competition with the seeded perennial species. Where erosion is a severe hazard, companion crops may be used in all MLRA's at the following maximum rates. Seeding rates for companion crops are lower than normal seeding rates for those crops to reduce competition with the seeded perennial species.

Barley:	10 lbs. per acre
Oats:	10 lbs. per acre
Spring wheat	15 lbs. per acre
Flax:	7 lbs. per acre

2. If used, the companion crop should be clipped and removed before it becomes competitive with the perennial species.

8. Management and Protection during Establishment:

A. Grazing

Do not graze until stand is fully established. This period will be a minimum of one full growing season. If an adequate stand has not established during the first growing season, or if seedlings do not have well-developed root systems with adventitious roots above the sown seed, then deferment should be extended through the second growing season. Grazing during the deferment period for weed control will be handled on a case by case basis provided no damage will be done to the seeded species.

B. Weed Control

During the establishment period, excessive amounts of competitive weeds will be controlled. Control weeds that compete with seedlings for sunlight and/or moisture during the growing season of the species planted. The first weed control operation will be needed as recommended or prior to weed seed maturity. Repeated weed control operations may be needed. Competitive weeds can be controlled either mechanically or chemically, or by a combination of these methods.

1. Mechanical - When controlling competitive weeds by clipping or mowing, adjust the equipment to cut above the new seedlings, and clip before the weeds set seed or mature. If the clippings are dense enough to smother the new seedlings, promptly remove clippings from the field.

2. Chemical - To control competitive weeds with herbicides use the appropriate herbicide(s) applied according to the manufacturer's label. The best control will generally be obtained when weeds are in the early stages of growth. Precautions should be taken to ensure that grass or legume seedlings are not injured by the selected herbicide(s). Refer to North Dakota State University, Agricultural Weed Control Guide (Cir. W-253 Rev.) for specific herbicide recommendations on forage crops in North Dakota.
http://www.ag.ndsu.nodak.edu/cropprod.htm

3. Noxious weeds must be controlled in accordance with state law.

C. Insect Control

Insects can be a threat to seedlings. Contact the County Extension Service for recommendations on control of specific insects affecting seeded species.

Caution:

When using any pesticides (herbicides or insecticides) read and follow the manufacturers label recommendations. Read and follow all directions and precautions on the label. The use of pesticides must be consistent with the label and in accordance with state and federal laws and regulations.

9. Guidelines for Stand Evaluation:

To determine adequacy of stands and to determine if reseeding or reinforcement seeding is required, use ND-CPA-9a, Stand Evaluation Worksheet, and the following guidelines:

A. It should be recognized that environmental factors, such as climate, insects, soils, and fertility affect time required for establishment of stands. Timeliness of precipitation, drought, extreme temperatures, severe winds, or late soil thaw can delay seedling emergence and/or development.

B. Seedling emergence should be relatively uniform over the area. The density of established plants required for an adequate stand will depend upon the planned purpose of the seeding and may vary from program-to-program. Consult program specific guidelines for additional information.

If specific practice or program guidelines are not available, stand counts should indicate a density of at least 3 to 5 seedlings per square foot of area. If at least three of the seedlings are rhizomatous species, the lower limit of three seedlings per square foot is adequate. The upper limit of five seedlings per square foot is necessary when all are bunch-type species or a mixture of rhizomatous and bunch-type species.

C. The adequacy of a stand will be based on density of established plants and stage of morphological development needed to ensure perenniality. To be considered established, a grass plant must have a well-developed adventitious root system and should exhibit signs of tillering or rhizome development. See Figure 1. An alfalfa plant must have a well-developed taproot with secondary and tertiary roots and a well-developed crown set below the soil surface and/or branch rhizome. For more information on alfalfa seedling development, see ND Extension Service publication R-648 "Alfalfa - Seed Germination - Seedling Growth - Vegetative Development" available at http://www.ext.nodak.edu/extpubs/hay.htm.

D. Preliminary stand evaluation can be made 4 to 8 weeks after germination; evaluate for progress and management problems (i.e. weeds, insects, etc.) - not for final establishment.

E. All stands must go through at least one winter before making final stand evaluation.

F. Stands resulting from late fall (dormant) or spring seedings must go through the first growing season and subsequent winter; evaluation for final establishment can be made any time during the second growing season.

G. Stands resulting from late summer seeding cannot be evaluated for final establishment until the end of subsequent, full growing season.

H. Most stands will require two growing seasons to become established; warm-season species may require three growing seasons for establishment.

I. Stand counts may either be done using a one-square foot frame or the row count method. If a frame count is used, all plants rooted within the frame should be counted. If the row count method is used, two side-by-side rows should be counted, the length to be determined by the row spacing. A 6-inch row spacing would require the observer to count all plants in two rows for a length of 12 inches; a 7-inch row spacing would require a 10.3 inch length of two rows; and an 8-inch row spacing would require a 9-inch length.

   A predetermined number of steps should be taken diagonal or perpendicular to the drill rows and the frame dropped at the toe of the foot on the final step. The frame should be dropped in a consistent alignment to the drill rows. The same procedure would be used when making a row count. Instead of dropping the frame at the toe of the foot, this point would then mark the beginning of the row count.

J. The number of samples required depends on factors such as stand uniformity and the number of species to be counted. Generally, a minimum of ten counts (or frames) per ten acres or less of field size would result in a representative sample. End rows, turn around areas or other areas that may have been double seeded should be avoided. Ten counts per ten acres of field size should only be used as a starting point. For example, a 70 to 80 acre pasture planting with a uniform stand may be sampled accurately using 40 counts or less. Whatever the situation, enough counts must be taken so that a representative sample is obtained.

K. ND-CPA-9a, Stand Evaluation Worksheet, may be used to document the stand counts.

L. If evaluation reveals a marginal stand, consideration should be given to allowing a second growing season for establishment. Seedings that contain a high percentage of "hard seed" are more likely to produce new seedlings during the second growing season.

M. The alternative of a partial reinforcement seeding, in lieu of the full seeding rate, should be considered during the evaluations.

N. "Spot" seeding weak areas may be a logical alternative in the case of spotty or intermittent stands, in lieu of whole field reseeding. Grazing deferment should follow spot seedings.

O. For guidance on stand enhancement or reinforcement seedings see ND Plant Materials Technical Note 15 (pending).

Table 1. Full Seeding Rates

Species	Growth Characteristics[1,2]	Seeds/Pound	MLRA 55A/B & 56 [3]		MLRA 53A/B, 54 & 58C/D [3]	
			Seed/SqFt	#PLS/Ac	Seed/SqFt	#PLS/Ac
Introduced Cool-Season Grasses						
Bromegrass						
Meadow	B/M	80,000	30	16.5	25	13.5
Smooth	R/M	135,000	25	8	20	6.5
Creeping foxtail	R/M	750,000	60	3.5	60	3.5
Hard fescue	B/S	565,000	50	4	35	3
Timothy	B/M	1,300,000	30	1	NR	NR
Wheatgrass						
Bluebunch-Quackgrass Hybrid	B/M	135,000	46	14	33	10
Crested	B/M	175,000	28	7	25	6
Intermediate	R/M	88,000	20	10	17	8.5
Pubescent	R/M	88,000	20	10	17	8.5
Siberian	R/M	175,000	30	7.5	25	6
Tall	B/T	79,000	23	13.5	20	11
Wildrye						
Altai	B/M	68,000	30	19	25	16
Dahurian	B/M	86,000	20	10	17	8.5
Mammoth	R/T	55,000	30	24	25	20
Russian	B/M	175,000	30	7.5	25	6
Native Cool-Season Grasses						
American mannagrass	R/T	1,280,000	45	1.5	45	1.5
Fowl bluegrass	B/M	3,156,000	70	1	70	1
Green needlegrass	B/M	180,000	30	7.5	25	6
Needle and thread	B/M	115,000	25	9.5	25	9.5
Nutall alkaligrass	B/S	2,108,000	50	1	50	1
Porcupine grass	B/M	57,000	25	19	25	19
Prairie junegrass	B/S	2,315,000	50	1	50	1
Reed canarygrass	R/T	530,000	40	3.5	40	3.5
Wheatgrass						
Bluebunch	B/M	140,000	NR	NR	25	8
Slender	B/M	155,000	25	5.5	17	5
Streambank/Thickspike	R/M	155,000	30	8.5	25	7
Western	R/M	112,000	25	10	20	8
Whitetop	R/T	191,000	11	2.4	NR	NR
Wildrye						
Basin	B/T	140,000	NR	NR	25	8
Beardless	R/M	150,000	30	8.5	25	7.5
Canada	B/M	115,000	20	7.5	17	6.5

Table 1. Full Seeding Rates - continued

Species	Growth Characterists[1,2]	Seeds/Pound	MLRA 55A/B & 56 [3]		MLRA 53A/B, 54 & 58C/D [3]	
			Seed/SqFt	#PLS/Ac	Seed/SqFt	#PLS/Ac
Native Warm-Season Grasses						
American sloughgrass	St/S	1,150,000	25	0.9	25	0.9
Bluestem						
Big	R/T	176,000	30	7.5	25	6
Little	B/M	286,000	30	4.5	25	4
Sand	R/T	113,000	30	12	25	9.5
Buffalograss	St/S	50,000	30	26	25	23
Grama						
Blue	B/S	750,000	40	2.5	30	2
Sideoats	R/S	180,000	30	7.5	25	6
Indian ricegrass	B/M	235,000	30	5.5	25	4.5
Indiangrass	R/T	193,000	30	7	25	5.5
Prairie cordgrass	R/T	183,000	30	7	30	7
Prairie sandreed	R/T	275,000	30	5	25	4
Prairie dropseed	B/M	224,000	25	5	25	5
Sand dropseed	B/M	5,680,000	70	0.5	70	0.5
Switchgrass	R/T	390,000	40	4.5	30	3.5
Native Grass-likes						
Fox sedge (Carex vulpinoidea)	B/S	1,600,000	37	1	37	1
Slough sedge (Carex atherodes)	R/M	230,490	25	4.7	25	4.7
Native Forbs and Legumes						
American vetch	Pr/P	30,000	25	36	25	36
Black-eyed susan	E/P	1,450,000	25	0.8	25	0.8
Blanket flower	E/P	157,000	25	7	25	7
Blue verbane (V.hastata)	E/P	1,488,000	34	1	34	1
Lewis flax	E/P	287,000	25	3.8	25	3.8
Canada milkvetch	E/P	266,000	25	4	25	4
Coneflower						
Narrow leaf purple	E/P	120,000	25	9	25	9
Prairie (yellow)	E/P	737,000	25	1.5	25	1.5
Purple	E/P	120,000	25	9	25	9
Cudweed sagewort	E/P/R	4,000,000	25	0.3	25	0.3
Dotted gayfeather	E/P	136,000	25	8	25	8
Maximillian sunflower	E/P/R	250,000	25	4.4	25	4.4
Plains coreopsis	E/A	1,650,000	25	0.7	25	0.7
Purple prairieclover	E/P	290,000	25	3.8	25	3.8
Shell-leaf penstemon	E/P	273,000	25	4	25	4
Stiff sunflower	E/P/R	85,000	25	12.8	25	12.8
Western yarrow	E/P/R	2,800,000	25	0.4	25	0.4
White prairieclover	E/P	278,000	25	3.9	25	3.9

Table 1. Full Seeding Rates - continued

Species	Growth Characterists[1,2]	Seeds/Pound	MLRA 55A/B & 56 [3] Seed/SqFt	MLRA 55A/B & 56 [3] #PLS/Ac	MLRA 53A/B, 54 & 58C/D [3] Seed/SqFt	MLRA 53A/B, 54 & 58C/D [3] #PLS/Ac
Introduced Legumes						
Alfalfa	E/P	210,000	30	6.5	25	5.5
Birdsfoot trefoil	Pr/P	418,000	50	5	NR	NR
Black medic	E/A	280,000	25	4	25	4
Cicer milkvetch	Pr/P	134,000	30	10	25	8
Clover						
Alsike	Pr/P	680,000	50	3	50	3
Ladino (white clover)	Pr/P	800,000	25	1.5	25	1.5
Red	Pr/P	275,000	30	5	NR	NR
Strawberry	E/P	300,000	25	3.5	25	3.5
Sweet	E/Bi	260,000	25	4	20	3
Hairy vetch	Pr/A	20,000	30	6.5	25	5.5
Sainfoin	E/P	22,000	30	6	25	5
Native Shrubs						
Buffaloberry	E/P/R	41,000	4	4.2	4	4.2
Chokecherry	E/P/R	5,000	3	26	3	26
Currant	E/P	240,000	30	5.5	25	4.5
False indigo	E/P	52,000	30	25	25	21
Fourwing saltbush						
Dewinged	E/P	52,000	7	6	7	6
Gardner saltbush	E/P	110,000	30	12	25	10
Juneberry	E/P/R	82,000	30	16	25	13
Leadplant	E/P	200,000	30	6.5	25	5.4
Prairie rose	E/P/R	45,000	30	29	25	24
Western snowberry	E/P/R	74,400	30	17.5	25	14.6
Winterfat	E/P	150,000	30	8.5	25	7

[1] For additional information see http://plants.usda.gov/.

Abbreviation [2]	Growth characteristic
A	Annual
B	Bunch
Bi	Biennial
E	Erect
M	Mid 18" - 36"
P	Perennial
Pr	Prostrate
R	Rhizomatous
S	Short < 18"
St	Stoloniferous
T	Tall > 36"

[3] See Section 1 of the Field Office Technical Guide for a map of the Major Land Resource Areas (MLRA) of North Dakota.

Table 2. Approved Named Varieties

Species		Recommended varieties for North Dakota
	.	**Origin of non-varietal ('common') grass seed of both native and introduced is limited to ND, SD, NE, MT, WY, MN, and Alberta, Saskatchewan and Manitoba**
Introduced cool-season grasses:		
Bromegrass		
	Meadow	Fleet, Paddock, Regar
	Smooth	Carlton, Signal, Magna, Manchar, Badger, Radisson, Rebound, Beacon, Barton, Baylor, Saratoga, Lincoln
Creeping foxtail		Retain, Garrison
Hard fescue		Discovery, Aurora, Reliant, Durar
Timothy		Climax, Itasca, Winmor
Wheatgrass		
	Bluebunch/Quackgrass Hybrid	NewHy
	Crested	
	Type: Standard	Nordan, RoadCrest, Summit
	Fairway	Ephraim, Ruff, Parkway, Fairway
	Hybrid	CD-II, Kirk, HyCrest
	Intermediate	Reliant, Clarke, Slate, Chief, Oahe
	Pubescent	Manska, Greenleaf, Mandan 759
	Siberian	Vavilov, P-27
	Tall	Orbit, Platte, Jose, Alkar
Wildrye	Altai	Pearl, Eejay, Prairieland
	Dahurian	Arthur, James
	Mammoth	Volga
	Russian	Mankota, Tetracan, Bozoisky Select, Swift, Vinall
Native warm and cool-season grasses:		
American mannagrass		Common
Fowl bluegrass		Common
Green needlegrass		Lodorm
Needle and thread		Common
Nutall alkaligrass		Common
Porcupine grass		Common
Prarie junegrass		Common
Reed canarygrass		Palaton, Venture, Vantage, Rise
Wheatgrass	Bluebunch	Goldar, Secar
	Slender	Adanac, Pryor, Revenue, Primar
	Streambank/Thickspike	Bannock, Elbee, Critana, Sodar
	Western	Rodan, Walsh, Flintlock, Rosana
Wildrye	Basin	Trailhead, Magnar
	Beardless	Shoshone
	Canada	Mandan

Species		Recommended varieties for North Dakota
Bluestem	Big	Sunnyview, Bison, Bonilla
	Little	Badlands, Itasca
	Sand	Goldstrike, Garden
Buffalograss		Bismarck ecotype (veg), Tatanka
Grama	Blue	Bad River
	Sideoats	Killdeer, Pierre, Butte
Indian ricegrass		Rimrock, Nezpar
Indiangrass		Tomahawk
Prairie cordgrass		Red River
Prairie sandreed		Goshen
Prairie dropseed		Common
Sand dropseed		Common
Switchgrass		Dacotah, Forestburg, Sunburst
Native Grass-likes:		
Fox sedge (Carex vulpinoidea)		Common
Slough sedge (Carex atherodes)		Common
		Non-varietal ('common') native forbs and legumes will originate or be grown in ND, SD, NE, MT, WY, ID, WA, OR, MN, WI, IA, Alberta, Saskatchewan or Manitoba
Native legumes/forbs:		
American vetch		Common
Black-eyed susan		Common
Blanket flower		Common
Blue verbane (Verbena hastata)		Common
Lewis flax		Appar
Canada milkvetch		Sunrise
Coneflower	Narrow-leaved purple	Bismarck
	Prairie (yellow)	Common
	Purple	Common
Cudweed sagewort		Summit
Dotted gayfeather		Common
Maximillian sunflower		Medicine Creek
Plains coreopsis		Common
Purple prairieclover		Bismarck
Shell-leaf penstemon		Common
Stiff sunflower		Bismarck
Western yarrow		Common
White prairieclover		Antelope

Species		Recommended varieties for North Dakota
Introduced legumes:		
Alfalfa [2]		**Fall dormancy rating or Winter Survival Index (WSI) of 3 or less [1]**
Birdsfoot trefoil		Leo, Empire, Viking
Black medic		George
Cicer milkvetch		Lutana, Monarch, Windsor
Clover	Alsike	Common
	Ladino (white clover)	Common
	Red	Common
	Strawberry	Common
	Sweet	Common
Hairy vetch		Common
Sainfoin		Eski
Shrubs:		
Buffaloberry		Sakakawea
Chokecherry		Common
Currant		Common
False indigo		Common
Fourwing saltbush	Dewinged	Wytana, Snake River
Gardner saltbush		Common
Juneberry		Common
Leadplant		Common
Prairie rose		Common
Western snowberry		Common
Winterfat		Common

[1] The following web sites are approved for use in determining approved alfalfa varieties: http://www.alfalfa.org/falldormancy.html or http://www.maes.umn.edu/maespubs/vartrial/vt-cntnt.html. Varieties must have a fall dormancy rating or Winter Survival Index (WSI) of three or less to meet specifications. Alfalfa varieties not listed on these web pages will require documentation from the distributor or developer to determine suitability.

[2] A partial list of grazable type alfalfas can be found at "Developing Alfalfa Adapted to Grazing in the Northern Great Plains" available at http://www.ag.ndsu.nodak.edu/streeter/forage_research_index.htm

Table 3. Species Characteristics

Species		Drought Tolerance [1]	Flood Tolerance [2]	Salt Tolerance [3]	Recovery After Harvest [4]	Season of Use [5]	Longevity [6]	C Pre
Introduced Grasses								
Bromegrass								
	Meadow	Fair	Fair	Poor	Good	Sp, F	Medium	
	Smooth	Fair	Good	Poor	Good	Sp, F	Long	
Creeping foxtail		Poor	Good	Poor	Good	Sp, Su, F	Long	
Hard fescue		Good	Fair	Fair	Good	Sp, F	Medium	M
Timothy		Poor	Good	Poor	Good	Sp, F	Short	M
Wheatgrass								
	Bluebunch/Quackgrass Hybrid	Fair	Good	Good	Good	Sp	Long	
	Crested	Good	Poor	Fair	Fair	Sp, F	Long	M
	Intermediate	Fair	Fair	Fair	Fair	Sp	Long	
	Pubescent	Fair	Fair	Fair	Fair	Sp	Long	
	Siberian	Good	Poor	Fair	Fair	Sp, F	Long	M
	Tall	Fair	Good	Good	Fair	Sp, F, W	Medium	
Wildrye								
	Altai	Fair	Good	Fair	Poor	Sp, F, W	Medium	M
	Dahurian	Fair	Fair	Fair	Good	Sp	Short	M
	Mammoth	Good	Poor	Fair	Fair	Sp	Long	
	Russian	Good	Fair	Fair	Good	Sp, F, W	Medium	
Native Cool-Season Grasses								
Green needlegrass		Good	Fair	Fair	Good	Sp, F	Long	
Needle and thread		Good	Fair	Fair	Fair	Sp	Long	M
Nutall alkaligrass		Poor	Good	Good	Fair	Sp	Long	
Porcupine grass		Good	Fair	Fair	Good	Sp	Long	M
Prairie junegrass		Good	Poor	Poor	Poor	Sp	Long	
Reed canarygrass		Fair	Good	Poor	Good	Sp, Su,	Long	

Table 3. Species Characteristics - continued

Species		Drought Tolerance [1]	Flood Tolerance [2]	Salt Tolerance [3]	Recovery After Harvest [4]	Season of Use [5]	Longevity [6]	C Pre
	Western	Good	Good	Good	Fair	Sp, Su, F	Long	M
Wildrye								
	Basin	Good	Fair	Fair	Fair	Sp, F	Long	
	Beardless	Fair	Fair	Good	Poor	Su, F	Long	M
	Canada	Fair	Good	Fair	Fair	Sp, F	Short	M
Native Warm-Season Grasses								

Bluestem								
	Big	Fair	Good	Poor	Good	Su	Long	
	Little	Good	Poor	Fair	Fair	Su, F	Long	M
	Sand	Good	Fair	Poor	Fair	Su, F	Long	
Buffalograss		Good	Poor	Good	Fair	Su	Long	
Grama								
	Blue	Good	Poor	Fair	Poor	Su	Long	
	Sideoats	Good	Poor	Fair	Fair	Su, F	Long	
Indian ricegrass		Good	Poor	Poor	Fair	Su	Long	
Indiangrass		Fair	Good	Poor	Good	Su, F	Long	
Prairie cordgrass		Poor	Good	Good	Fair	Sp	Long	M
Prairie sandreed		Good	Poor	Poor	Fair	Su, F	Long	M
Prairie dropseed		Fair	Good	Poor	Fair	Su	Long	M
Sand dropseed		Good	Poor	Poor	Poor	Su	Short	
Switchgrass		Fair	Good	Fair	Fair	Su, F	Long	M
Native								
Forbs/Legumes								
American vetch		Good	Poor	Poor	NR	NR	Medium	
Black-eyed susan		Good	Good	Poor	NR	NR	Short	
Blanket flower		Good	Fair	Poor	NR	NR	Medium	
Lewis flax		Good	Fair	Poor	NR	NR	Medium	
Canada milkvetch		Fair	Good	Poor	NR	NR	Short	

Table 3. Species Characteristics - continued

Species		Drought Tolerance [1]	Flood Tolerance [2]	Salt Tolerance [3]	Recovery After Harvest [4]	Season of Use [5]	Longevity [6]	C Pre
Coneflower								
	Narrow leaf purple	Good	Poor	Poor	NR	NR	Long	
	Prairie (yellow)	Good	Fair	Poor	NR	NR	Medium	
	Purple	Good	Poor	Poor	NR	NR	Long	
Cudweed sagewort		Good	Poor	Poor	NR	NR	Long	
Dotted gayfeather		Good	Poor	Poor	NR	NR	Long	
Maximillian sunflower		Poor	Good	Poor	NR	NR	Long	
Plains coreopsis		Good	Good	Poor	NR	NR	Short	
Purple prairieclover		Good	Fair	Fair	NR	NR	Medium	
Shell-leaf penstemon		Good	Poor	Poor	NR	NR	Short	
Stiff sunflower		Good	Good	Poor	NR	NR	Long	
Western yarrow		Good	Good	Fair	NR	NR	Long	
White prairieclover		Good	Fair	Fair	NR	NR	Medium	
Introduced Legumes								
Alfalfa		Good	Poor	Poor	Good	Sp, Su	Medium	
Birdsfoot trefoil		Fair	Fair	Poor	Good	Sp, Su	Medium	
Black medic		Fair	Fair	Fair	Poor	Sp, Su	Short	
Cicer milkvetch		Good	Fair	Fair	Good	Sp	Long	
Clover								
	Alsike	Poor	Good	Fair	Good	Sp, Su	Short	
	Ladino (white clover)	Poor	Good	Fair	Fair	Sp, Su	Short	
	Red	Fair	Fair	Poor	Fair	Sp, Su	Short	
	Strawberry	Fair	Good	Good	Fair	Sp, Su	Long	
	Sweet	Good	Fair	Good	Poor	Sp, Su	Medium	
Hairy vetch		Fair	Fair	Poor	Fair	Su, F	Short	
Sainfoin		Good	Poor	Poor	Fair	Sp, Su	Medium	

Table 3. Species Characteristics - continued

Species	Drought Tolerance [1]	Flood Tolerance [2]	Salt Tolerance [3]	Recovery After Harvest [4]	Season of Use [5]	Longevity [6]	Pr
Native Shrubs							
Buffaloberry	Good	Poor	Good	NR	NR	Long	
Chokecherry	Fair	Fair	Poor	NR	NR	Long	
Currant	Good	Fair	Fair	NR	NR	Medium	
False indigo	Poor	Good	Poor	NR	NR	Medium	
Fourwing saltbush	Good	Poor	Good	NR	NR	Long	
Gardner saltbush	Good	Poor	Good	NR	NR	Long	
Juneberry	Poor	Good	Poor	NR	NR	Long	
Leadplant	Good	Poor	Poor	NR	NR	Long	
Prairie rose	Good	Fair	Poor	NR	NR	Long	
Western snowberry	Fair	Fair	Poor	NR	NR	Long	
Winterfat	Good	Poor	Poor	NR	NR	Long	

NR – Not Rated

[1] Drought Tolerance**:** Based on species being on an adapted site.

[2] Flood Tolerance: Good - 28-42 days, Fair - 14-28 days, Poor - less than 14 days. Creeping foxtail and reed canarygrass can toler

[3] Salt Tolerance: Based on SAR (Sodium Adsorption Ratio) Values 1-5 poor, 6-10 fair, 11-14 good. No species available for 15+ va

[4] Recovery after Harvest: Based on adequate soil moisture

[5] Season of Use: Sp - spring; Su - summer; F - fall; W - winter

[6] Longevity: Short 1-4 years; Medium 5-10 years; Long - longer than 10 years with proper management.

[7] Grazing Preference: Based on season of rapid growth. Palatability is relative, depending on quantity, quality, and availability of otl
Grazing preference shown is for cattle and will vary for other species of domestic livestock or wildlife.

[8] Stand Establishment: Rapid - usually 1 growing season after planting; Medium - usually 1-2 growing seasons after planting;
Slow - usually 2-3 growing seasons after planting.

Figure 1. Grass seedling morphology